

REMARKS

Claims 1-4 and 6-8 are presently pending in the application.

The Examiner has again rejected claims 1-4 and 6-8 under 35 U.S.C. § 102(e) as being anticipated by or under 35 U.S.C. § 103(a) as being obvious over each of U.S. Patents Nos. 6,358,648 of Hayashi et al. ("Hayashi") and 6,083,642 of Kato et al. ("Kato"). Applicants respectfully traverse these rejections and the arguments in support thereof for the reasons set forth in the previous Amendments, which Applicants rely upon in full, and for the additional reasons set forth below, and respectfully request reconsideration and withdrawal of the rejections.

Rejections Under §§ 102(e) and 103(a) Based on Hayashi and on Kato

The Examiner's arguments in support of his rejections based on Hayashi and on Kato are essentially identical to those in the previous Office Action and will only be summarized here for convenience. Briefly, the Examiner contends that Hayashi teaches all of the attributes of the claimed positive electrode active material either explicitly (such as elemental composition and mean particle size) or inherently. Specifically, the Examiner takes the position that since the positive electrode active materials disclosed by Hayashi and the present application have similar chemistry and manufacturing procedures, properties of the Hayashi material which are not disclosed, such as BET surface area, particle size distribution and full width at half maximum of a particular crystallographic orientation, are inherent. Additionally, the Examiner contends that it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the pH values or the degree of mixing and stirring of the solution, such that the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the total number of particles in the positive electrode active material.

Similarly, the Examiner maintains that Kato also teaches or suggests all of the claimed elements, including a positive electrode material for an alkaline storage battery comprising nickel hydroxide particles and a higher cobalt oxide, in which the NiOH particles have the claimed particle size and surface area. The Examiner takes the position that other properties of the material, such as particle size distribution and full width at half maximum of a particular crystallographic orientation, are inherent, given that the positive electrode active materials disclosed by Kato and the present application have similar chemistry and manufacturing

procedures. The Examiner again contends that it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the pH values, the degree of mixing, or the heating temperature of the solution, such that the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the total number of particles in the positive electrode active material.

Applicants previously argued that U.S. Patent No. 6,040,007 of Junichi shows particles having irregular shapes which are similar to those disclosed by Hayashi and Kato; that neither Hayashi nor Kato teaches controlling the raw material solution at a constant temperature; and that as shown in the Table and in the specification, batteries having higher capacity and longer life cycle are obtained by improving both the particle circularity and the particle size uniformity of the active material. In response, the Examiner argues that since the assignee of the '007 patent and the cited references are different, Applicants' conclusions regarding the similarity between the materials described in these applications is speculative and not supported by circumstantial evidence. Further, the Examiner contends that since Hayashi and Kato identify pH, stirring of the solution, and solution temperature as processing parameters in the fabrication of positive electrode active materials, it would have been within the ordinary skill in the art to adjust the pH and degree of mixing of the solution to yield nickel hydroxide or nickel oxyhydroxide powders of desired circularity and distribution of circularity.

Finally, the Examiner contends that Table 1 shows four batteries that employing anode active materials corresponding to Examples 1 to 4, respectively. The powder of Example 1 has a mean circularity of 0.95 and the number of particles having a circularity of not larger than 0.85 accounts for 10% of the number of total particles. The Examiner contends that the battery of Example 1 exhibits similar battery capacity, percentage value, and capacity maintenance rate to the batteries of Examples 1-4, despite the fact that the number of particles having a circularity of not larger than 0.85 is more than 5%. Therefore, the Examiner concludes that it would be inconsistent to conclude that specific circularity and circularity distribution, as recited in claim 1, are critical in obtaining a battery of improved and unexpected performance, and that the burden is on Applicants to establish results that are unexpected and significant.

For all of these reasons, the Examiner maintains that both Kato and Hayashi anticipate or render obvious all of the pending claims. Applicants again traverse these rejections for the reasons set forth previously and for the additional reasons which follow.

The present invention relates to a positive electrode active material for an alkaline storage battery containing a nickel hydroxide powder and/or a nickel oxyhydroxide powder, in which the positive electrode active material exhibits particular physical properties, and a method of making a positive electrode using such a positive electrode active material. The positive electrode active material has a mean particle circularity from 0.95 to 1, and the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the total number of particles within the positive electrode active material. When preparing the active materials according to the invention, the temperature of the raw material solutions are adjusted. In contrast, Kato and Hayashi do not teach or suggest such temperature adjustment, and thus the active materials of the prior art differ from the active material according to the invention.

The battery of Comparative Example 1, corresponding to prior art batteries, in which the temperatures of the raw material solutions are not adjusted when preparing the nickel hydroxide powder, exhibits a mean particle circularity of 0.94 and the number of particles having a circularity of not larger than 0.85 is 10%. In the battery of Example 2, corresponding to claim 1, the mean particle circularity is 0.96 and the number of particles having a circularity of not larger than 0.85 is 5%. As shown in Table 1, the battery of Example 2 exhibits an improvement in battery capacity and capacity maintenance rate: the battery according to the invention has an increased capacity of 95 mAh, an increase in the percentage value $C_{10A}/C_{0.4A} \times 100$ of 3%, and an increase in the capacity maintenance rate of 7%.

Considering the batteries of Example 1-3, it can be seen that as the number of particles having a circularity of not larger than 0.85 decreases, the battery capacity, the percentage value $C_{10A}/C_{0.4A}$, and the capacity maintenance rate improve. Specifically, comparing the battery of Example 1 (number of particles having a circularity not greater than 0.85 is 10%) to the battery of Example 2 (number of particles having a circularity not greater than 0.85 is 5%), the battery capacity decreases by 48 mAh, the percentage value $C_{10A}/C_{0.4A}$ decreases by 1%, and the capacity maintenance rate decreases by 3%. Accordingly, reducing the percentage of particles having a circularity not greater than 0.85 from 10% to 5% has a significant effect on battery properties.

Further, comparing the battery of Example 1 to the battery of Example 3 (number of particles having a circularity not greater than 0.85 is 2.5%), the battery capacity decreases by 84 mAh, the percentage value $C_{10A}/C_{0.4A}$ decreases by 2%, and the capacity maintenance rate

decreases by 5%. This further demonstrates the significant effect of decreasing the percentage of particles having a circularity not greater than 0.85.

The technical field of alkaline storage batteries is quite advanced; many techniques and methods have been developed for achieving higher battery capacity. However, attempts have not conventionally been made to increase battery capacity by controlling the shapes of active materials. According to the present invention, however, by increasing the particle circularity and by decreasing the number of particles having a particle circularity of not larger than 0.85, i.e., by merely adjusting the shapes of the active material particles, the battery capacity, the percentage value $C_{10A}/C_{0.4A}$, and the capacity maintenance rate are improved.

Therefore, while the Examiner contends that the differences in the values in Table 1 representing the properties of different batteries are not significant, one skilled in the art would not easily be able to predict the increases in battery capacity, percentage value $C_{10A}/C_{0.4A}$, and capacity maintenance rate which are observed by the batteries according to the present invention. In other words, since so much research has been performed and so many methods developed for increasing battery capacity, any additional increase which is obtainable is significant in such a mature and well-developed field.

Therefore, since Kato and Hayashi do not teach or suggest controlling the raw material solution at a constant temperature, that the particle circularity of the active material is not smaller than 0.95, nor that the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the number of total particles, one skilled in the art would not arrive at the present invention based on the prior art. Further, the significant effects observed in the batteries and active materials according to the invention relative to those in the prior art would overcome any *prima facie* case of obviousness, were one to be established.

Finally, Applicants maintain that since Hayashi and Kato do not recognize the parameters which needed optimization, that is, particle circularity and circularity distribution, nor the profound effects such parameters would have on the resulting battery properties, one skilled in the art would not have been motivated to adjust the reaction conditions of the prior art in order to arrive at the claimed positive electrode active material. Rather, such an assumption which is made by the Examiner is merely hindsight from the present invention.

Application No. 10/081,087
Reply to Office Action of January 10, 2005

For all of these reasons, Applicants respectfully submit that the pending claims are not anticipated by or rendered obvious over Hayashi or Kato, and reconsideration and withdrawal of the § 102(e) and § 103(a) rejections are respectfully requested.

In view of the above Remarks, Applicants respectfully submit that the pending claims are patentably distinct over the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.


Respectfully submitted,

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April 7, 2005

(Date)

By


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